CONNECTOR ADAPTED TO BE USED FOR TRANSMISSION OF A BALANCED SIGNAL AND SUBSTRATE FOR MOUNTING THE CONNECTOR

This application claims priority to prior Japanese application JP 2003-111567, the disclosure of which is incorporated herein by reference.

Background of the Invention:

This invention relates to a connector suitable for connection of a transmission line or an electric line for transmitting a balanced signal and a substrate for mounting the connector.

A connector of the type is disclosed, for example, in Japanese Patent (JP-B) No. 3108239 and comprises an insulator and a plurality of pairs of signal contacts (signal contact pairs) held by the insulator. Each of the signal contact pairs are connected to a pair of transmission lines for transmitting a balanced signal.

Each of the signal contacts is formed primarily by press punching. In this case, each signal contact tends to be partially varied in sectional shape. It is therefore difficult to achieve impedance matching between the signal contacts in each of the signal contact pairs.

In case where the adjustment of impedance is essential and indispensable, it is inevitable to change the shape in punching. The change in shape in punching requires a high cost.

Summary of the Invention:

It is therefore an object of the present invention to provide a connector which has an excellent impedance characteristic and which is suitable for transmission of a balanced signal.

It is another object of the present invention to provide a connector which is capable of preventing occurrence of crosstalk between adjacent ones of the above-mentioned signal contact pairs.

It is still another object of the present invention to provide a substrate which is adapted to mount the above-mentioned connector and which is prevented from degradation in impedance characteristic.

Other objects of the present invention will become clear as the description proceeds.

According to one aspect of the present invention, there is provided a connector comprising an insulator and first and second signal contacts held by the insulator, each of the first and the second signal contacts comprising a fixed portion fixed to the insulator, a contacting portion connected to one end of the fixed portion and extending in a first direction, a bent portion connected to the other end of the fixed portion, a first intermediate portion extending from the bent portion in the first direction, a second intermediate portion extending from the first intermediate portion in a second direction perpendicular to the first direction, and a terminal portion extending from the second intermediate portion in the first direction, the first intermediate portion of the first signal contact and the first intermediate portion of the second signal contact being placed at positions which are different from each other in the second direction, the second intermediate portion of the first signal contact and the second intermediate portion of the second signal contact being different from each other in the first direction, the bent portions being shaped to make the first and the second signal contacts be substantially equal in total length to each other.

According to another aspect of the present invention, there is provided a substrate to be connected to the connector according to claim 1, the substrate comprising a plate portion, first and second signal pads disposed on a surface of the plate portion and adapted to be connected to the terminal portions of the

first and the second signal contacts, and a ground layer formed inside the plate portion and extending in parallel to the surface of the plate portion over an area except at least those portions faced to the first and the second signal pads in the second direction.

Brief Description of the Drawing:

Fig. 1 is a perspective view of a connector according to one embodiment of the present invention, together with a substrate for mounting the connector;

Fig. 2 is a perspective view of the connector illustrated in Fig. 1 with a part cut away along a line II-II, together with the substrate divided into two parts in a thickness direction for convenience of description;

Fig. 3 is a sectional view of a characteristic part of a contact portion, taken along a line III-III in Fig. 2;

Fig. 4 is a sectional view of a characteristic part of the connector, taken along a line IV-IV in Fig. 2;

Fig. 5 is a sectional view of a characteristic part, taken along a line V-V in Fig. 2, and shows the relationship between the contact portion and the substrate,;

Fig. 6 is an enlarged sectional view taken along a line VI-VI in Fig. 1; and

Fig. 7 is an enlarged sectional view taken along a line VII-VII in Fig. 1.

Description of the Preferred Embodiment:

Referring to Figs. 1 and 2, description will be made of a connector according to one embodiment of the present invention.

The connector depicted by 1 in the figure is a so-called angle connector and is coupled and connected to a mating connector (not shown) in a first direction A1 in order to connect a transmission line for transmitting a balanced signal. The connector 1 is mounted to a substrate 11, such as a printed board,

in a second direction A2 perpendicular to the first direction A1. A direction perpendicular to the first and the second directions A1 and A2 will be called a third direction A3.

The connector 1 comprises an insulator 2 and a number of pairs of conductive signal contacts (signal contact pairs) 3 and 4 held by the insulator 2. The signal contact pairs are arranged in parallel to one another at a predetermined pitch in the third direction A3. On opposite sides of every signal contact pair in the third direction A3, conductive ground contacts 5 are disposed adjacent to and spaced from the signal contact pair. Each of the ground contacts 5 extends in the first and the second directions A1 and A2 in a plate-like shape. Each ground contact 5 has a flat plate portion 5a press-fitted and fixed to the insulator 2 and a terminal portion 5b protruding from the flat plate portion 5a. The ground contacts 5 serve to prevent occurrence of crosstalk between the signal contact pairs. The insulator 2 has a coupling portion covered with a shell 6 on upper and lower sides thereof.

In the following description, one of the signal contacts in each pair will be called a first signal contact 3 and the other will be called a second signal contact 4. Each of the first and the second signal contacts 3 and 4 is formed by bending using a press technique and has a generally crank-like shape. Inside the insulator 2, the first signal contact 3 is disposed at a position higher than that of the second signal contact 4 as a whole. The first and the second signal contacts 3 and 4 form an electric pair upon transmission of the balanced signal.

The first signal contact 3 has a fixed portion 3a press-fitted and fixed to the insulator 2, a contacting portion 3b having elasticity, connected to one end of the fixed portion 3a, and extending forward in the first direction A1, i.e., in a coupling direction, a bent portion 3c connected to the other end of the fixed portion 3a, a first intermediate portion 3d extending from the bent portion 3c

rearward in the first direction A1, a second intermediate portion 3e extending from a rear end of the first intermediate portion 3d downward in the second direction A2, and a terminal portion 3f extending from a lower end of the second intermediate portion 3e rearward in the first direction A1 to be soldered to a substrate 11.

On the other hand, the second signal contact 4 has a fixed portion 4a press-fitted and fixed to the insulator 2, a contacting portion 4b having elasticity, connected to one end of the fixed portion 4a, and extending forward in the first direction A1, i.e., in the coupling direction, a bent portion 4c connected to the other end of the fixed portion 4a, a first intermediate portion 4d extending from the bent portion 4c rearward in the first direction A1, a second intermediate portion 4e extending from a rear end of the first intermediate portion 4d downward in the second direction A2, and a terminal portion 4f extending from a lower end of the second intermediate portion 4e rearward in the first direction A1 to be soldered to the substrate 11.

The contacting portion 3a of the first signal contact 3 and the contacting portion 4a of the second signal contact 4 are faced to each other with a space left therebetween in the second direction A2. The contacting portions 3a and 4a form a socket. Between the contacting portions 3a and 4a, a pin contact of the mating connector is inserted in contact therewith.

As is obvious from Fig. 3, the first intermediate portion 3d of the first signal contact 3 and the first intermediate portion 4d of the second signal contact 4 are displaced or shifted in position from each other in the second direction A2 by a distance X1 and also displaced or shifted in position from each other in the third direction A3. In other words, the first intermediate portions 3d and 4d are placed at positions which are different from each other in the second and the third directions A2 and A3.

As is obvious from Fig. 4, the second intermediate portion 3e of the first signal contact 3 and the second intermediate portion 4e of the second signal contact 4 are displaced or shifted in position from each other in the first direction A1 by a distance X2 and also displaced or shifted in position from each other in the third direction A3. In other words, the second intermediate portions 3e and 4e are placed at positions which are different from each other in the first and the third directions A1 and A3.

As is obvious from Fig. 5, the terminal portion 3f of the first signal contact 3 and the terminal portion 4f of the second signal contact 4 are disposed adjacent to each other in the third direction A3.

The bent portion 3c of the first signal contact 3 and the bent portion 4c of the second signal contact 4 cooperate with each other to make the first and the second signal contacts 3 and 4 be equal in total length to each other. Specifically, by changing the dimensions of the bent portions 3c and 4c of the first and the second signal contacts 3 and 4, the above-mentioned distances X1 and X2 are adjusted. As a result, it is possible to change the degree of electrical coupling between the first and the second signal contacts 3 and 4 and to adjust impedance upon transmission of the balanced signal.

Next referring to Figs. 6 and 7 in addition to Figs. 1 and 2, the substrate 11 will be described.

The substrate 11 has a multilayer micro strip line structure. The substrate 11 has a surface 11a provided with a number of signal pads 12 corresponding to the terminal portions 3f and 4f of the first and the second signal contacts 3 and 4, a number of ground pads 13 connected to the signal pads 12, and a number of ground pads 14 corresponding to the ground contacts 5. Inside the substrate 11, a ground layer 1t extends in parallel to the surface 11a.

In Fig. 2, the substrate 11 is divided into two parts in a thickness direction. The ground layer 15 is formed in a hatched region in the figure. Thus, the ground layer 15 extends over an area except at least those portions faced to the signal pads 12 in the second direction A2. In other words, the ground layer 15 is locally removed at the portions located below the signal pads 12. With the above-mentioned structure, it is possible to suppress the decrease in impedance without increasing occurrence of crosstalk between the signal contact pairs.

As shown in Fig. 5, the terminal portions 3f and 4f of the signal contacts 3 and 4 are soldered to the signal pads 12 of the substrate 11 by SMT (surface mount technology), respectively. The terminal portions 5b of the ground contacts 5 are soldered to the ground pads 13, respectively.

While the present invention has thus far been described in conjunction with the preferred embodiment thereof, it will be readily possible for those skilled in the art to put this invention into practice in various other manners without departing from the scope set forth in the appended claims. For example, press punching may form each of the signal contacts.